359/400 AU 257 40709
GB 0000398
SEP 1907

~~GB 01 1907~~
33

398 of '07
1907

SHEET 1.

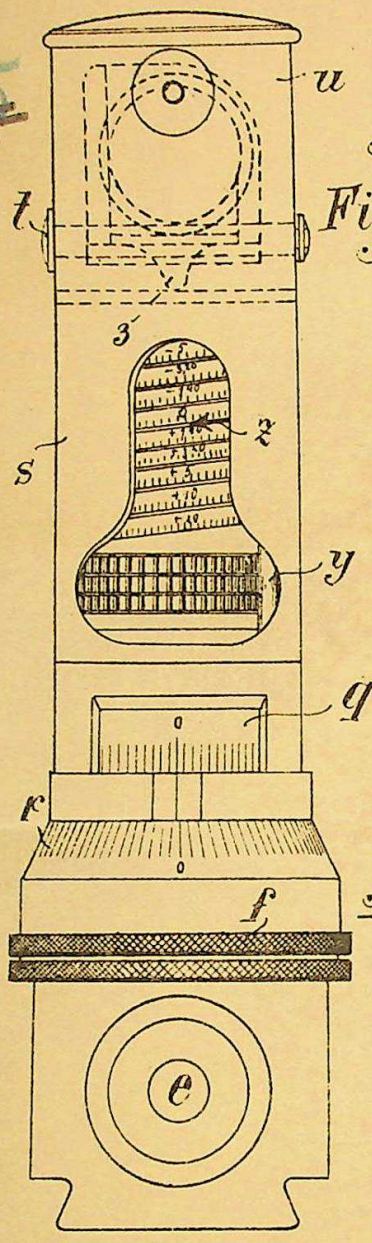


Fig. 1.

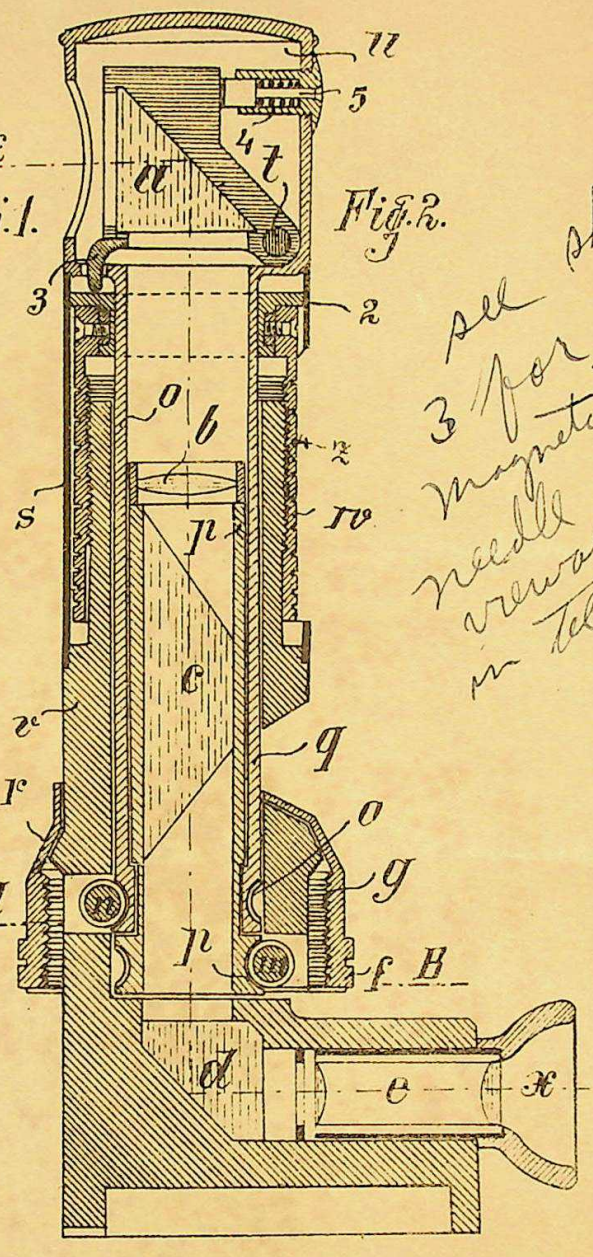


Fig. 2.

all sheet
3 for
magnetic
needle
viewable
in Telescope

U. S. Pat. No. 873,228. (Shows all but 8, 9, 10, 11.)
BRITISH. 398 of 1907.
GERMAN 184,550.
192,977.
Austrian. 33,744.
SWISS. 39,274.

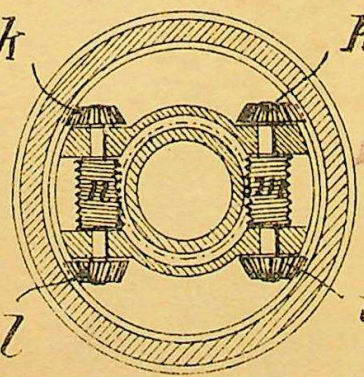


Fig. 3.

359/400

SWISS. 39,274

Fig. 4.

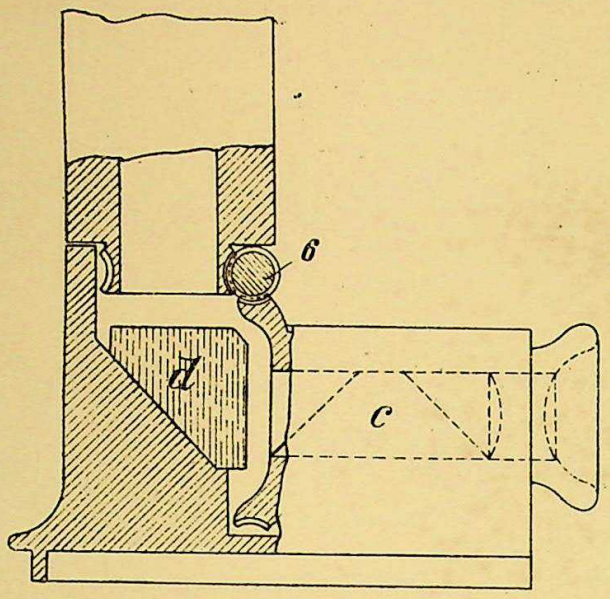


Fig. 5.

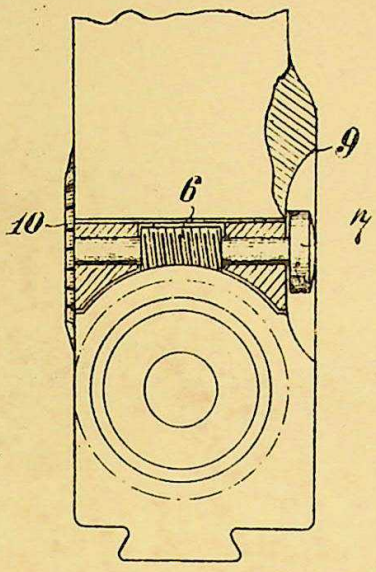


Fig. 6.

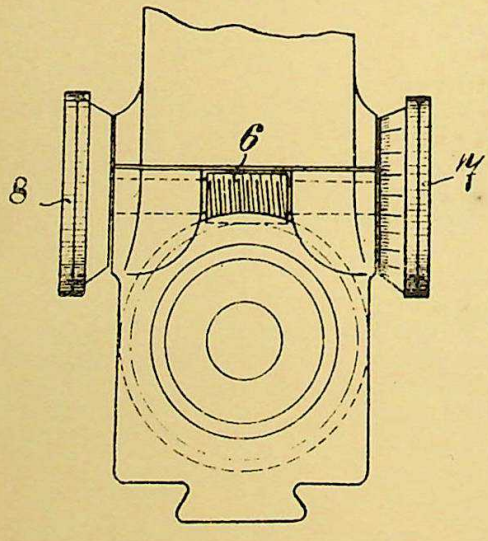
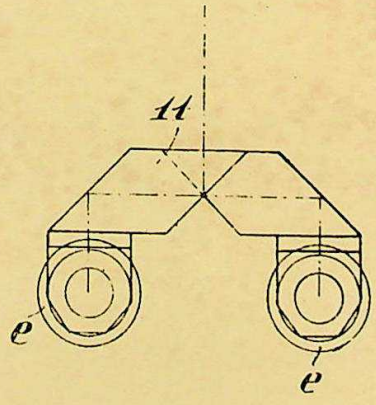


Fig. 7.



Malby & Sons, Photo-Litho.

Fig. 8.

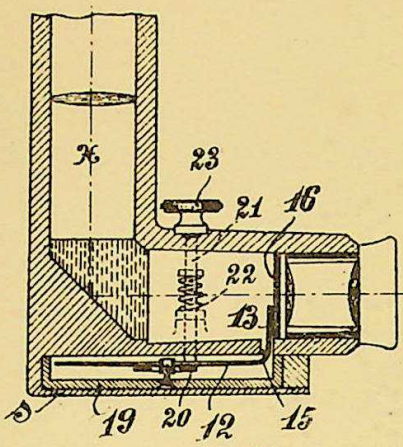
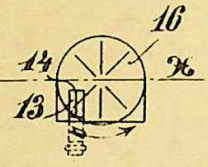


Fig. 9.



magnetic needle

Fig. 10.

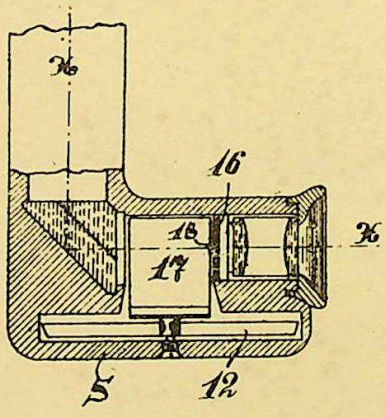
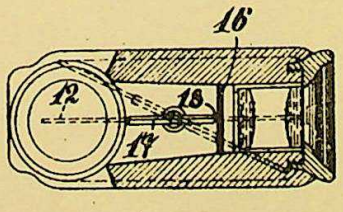


Fig. 11.



Murray & Sons, Photo-Litho.

7

33

N° 398 A.D. 1907

Duplicate.

Date of Application, 7th Jan., 1907—Accepted, 5th Sept., 1907

COMPLETE SPECIFICATION.

"Improvements in and relating to Telescopes".

I, ARWED HAHN, Manufacturer, of Wilhelmshöher Allee 25¾, Cassel, Germany, do hereby declare the nature of this invention and in what manner the same is to be performed to be particularly described and ascertained in and by the following statement:—

The present invention relates to improvements in telescopes for instruments of all kinds for measuring angles, for example, theodolites, levelling-instruments, compasses, telescopes for cannon, and so on.

According to the present invention the moving mechanism and the parts which serve for adjusting and setting the telescope are arranged within the casing or virtually form part of the casing being arranged concentrically outside the casing proper in the manner described more particularly hereinafter. The invention also consists in the combinations and arrangements of parts hereinafter described and claimed.

The invention is illustrated in the accompanying drawings, it being understood that the number of all possible constructions is not limited to those shown which are given merely by way of example. In said drawings:—

Fig. 1 is a front elevation of a telescope, of which
Fig. 2 is a longitudinal section.
Fig. 3 is a cross-section on the line A—B of Fig. 1.
Figs. 4—6 illustrate three other forms of the mechanism of the reflectors.
Fig. 7 represents diagrammatically a modification of a detail,
Fig. 8 shows by way of example a form for special purposes,
Fig. 9 being a view of a detail of said latter form,
Fig. 10 is a longitudinal section, and
Fig. 11 a transverse section through a modification of the latter form.
In Figs. 4, 5, 6, & 8 & 10 portions of the telescope are broken off.

The path of the rays of light is indicated by the line *x*—*x* (see Figs. 2, 8, and 10) composed of dots and dashes. The rays emitted by the object are reflected through a right angle by means of the receiving reflector *a* so that they pass through the object-glass *b* and the prism *c* into the prism *d*. Here the image if desired is reversed at a roof-like surface formed by two planes and after being reflected at right angles passes through the eye-piece *e* into the eye of the observer.

The particular arrangement of the individual optical parts is of course of no consequence. For example, the erecting reflector *c* may be arranged behind the reflector *d* without the general construction of the instrument being altered. Some of the figures of the accompanying drawings show forms in which this latter arrangement of the reflectors is adopted.

In the form shown in Fig. 1 the two reflectors *a* and *c* are moved in the following manner:

On turning the milled edge of the sleeve *f* the thread *g* on the inner surface of said sleeve rotates the worm-wheels *h*, *i*, *k*, *l*, which on their part are con-

[*Price* 8*d*.]

nected with the endless screws *m* and *n*. The endless screw *n* engages with the sleeve *o* rigidly connected with the receiving reflector *a* and on rotating causes said reflector to rotate horizontally, while the movement of the prism *c* serving to erect the image is effected by the rotation of the other screw *m*, which engages with its thread in the casing *p* of the prism *c*, the velocity ratio having a suitable value. The horizontal angle-values may then be read off for example on the ring *q* and the sloping surface *r* of the milled sleeve *f* or in any other suitable manner adapted for such instruments.

In order to enable the reflector *a* to move in a vertical direction as well as in a horizontal plane a drum is provided with a helical groove, said drum being so arranged that it is situated below the receiving reflector *a* and completely within the casing *s*. The reflector *a* is supported pivotally upon an axle *t* in the instrument head *u* which is adapted to turn in the manner above described. The reflector *a* is moved about the axle *t* by turning the drum *w* which is displaceable with regard to the fixed part *v* of the telescope and is provided on its surface with a groove running helically around it, said groove in its entire length representing the path employed for the graduations. This groove serves to guide a pointer *z* adapted to slide on a rod *y*, the position of which pointer gives the value of the angle made with the horizontal plane measured by turning the receiving reflector. The whole device is completely enclosed by the protecting cap *s* which possesses merely a necessary opening for enabling the values of the angles to be read off.

In the form shown in Figs. 1 and 2 the drum *w* on being moved raises or lowers according to its direction of rotation the ring 2 which is directly connected with it. This movement is then performed also by the receiving reflector *a* which during its horizontal rotation slides with a nose 3 continually on the ring 2. The uniform pressure of the nose 3 on the ring 2 can be assured in case of need by means of a spring 4 which presses the pin 5 against the back vertical surface of the reflector-mount. A similar effect is obtained if the nose 3 is rigidly connected by means of a link, joint, or the like with the ring 2 which in this case is arranged revolubly with regard to the drum *w*.

In order still further to improve the fineness with which the parts can be adjusted, which is desirable for many instruments, an additional drum may be inserted between the drum *w* and the reflector *a*. The latter drum is then prevented from rotating and is provided on its outer periphery or even its inner periphery with a thread running in the opposite sense to the thread on the drum *w* and having a different pitch from that of said latter thread. In this manner only the difference between the motions of the two drums is transmitted to the reflector *a*, whereby in consequence of the increased length of the path to be measured the same can be more finely graduated.

If, as already mentioned above, the second reflector *c* lies behind the reflector *d*, the mechanism can be simplified by rotating both reflectors *a*, *c* by means of a common screw 6. This case is shown in Figs. 4 to 7. In order also in this case to prevent delicate parts from projecting out, the worm or endless screw 6 is placed as near to the central axis of the instrument as possible. In order to enable it to be actuated the worm or endless screw 6 is provided with suitably constructed means for turning it by hand. In the forms shown in Figs. 5 and 6 the endless screw 6 is rotated directly by means of milled heads 7 and 8 mounted on the same spindle. For instruments which are exposed to rough treatment, as for example telescope-sight on cannon, the arrangement shown in Fig. 5 is to be recommended, as in this case the head 7 is protected by the edge of the casing which spans it round. For this head 7 a key might be substituted which could be placed on a square on the spindle of the endless screw 6 and be removed when not in use. In Fig. 5 a disc 10 is provided for reading off the angle, said disc rotating with the screw 6 and being furnished with a scale, while on the casing a mark is provided. In order to enable the adjustments to be made with exactness, the endless screw 6 can be driven by means corresponding to

those represented in Figs. 1 to 3, namely, by means of a milled sleeve *r* provided with an internal thread and by means of worm-wheels.

If the instrument is intended to be of the binocular type, an arrangement of prisms 11 somewhat as shown in Fig. 7 may be employed.

The remaining figures show forms which are particularly intended for such instruments as those in which measurements are made with the magnetic meridian as a basis.

In order always to be able to check the instrument with regard to its position with reference to the magnetic meridian and to be able to do so even during the operation of sighting, a magnetic needle is arranged on it, the position of which is observed at any time in the field of view. The device may be arranged in such a way that the oscillations of the needle appear in the field of view of the telescope, as oscillations of an extremely fine perpendicular line under the magnification of the eye-piece, said line when the telescope is set correctly covering the perpendicular thread of the diaphragm (hair-cross).

This form of the invention is shown in Fig. 8 in longitudinal section, while Fig. 9 shows diagrammatically how the mark which indicates the oscillations of the needle appears in the field of view.

The magnetic needle 12 is arranged at a suitable place and is preferably completely enclosed by the casing of the telescope, one end of said needle being provided with a mark which projects into the field of view of the telescope perpendicularly to the optical axis. In the case of the form represented the needle 12 carries a small perpendicular glass plate 13 which possesses the very fine line 14 above the middle of the needle. The small glass plate 13 with the line 14 projects through the slot 15 into the field of view of the telescope and swings directly in front of the diaphragm (hair-cross) 16. The slot 15 must be of such a breadth that there is sufficient room for the magnetic needle 12 to swing. The mark may of course be formed in any other suitable manner, for example, by a fine hair, fine wire, or the like. The only requisite is that the field of view of the instrument is not restricted.

Another arrangement of this form is shown in Figs. 10 and 11 in longitudinal and transverse section respectively. In this case the needle 12 is connected directly with a plate 17 of any suitable material in such a manner that the longitudinal axis of the plate is parallel with the axis of the needle 12. Consequently when the instrument stands exactly in the magnetic meridian, the plate, the axis of the telescope and that of the magnetic needle all lie in one plane. The thin edge 18 then appears to the observer as a fine perpendicular line in the field of view of the telescope and covers itself with the corresponding line of the hair-cross 16, so that the field of view is not detrimentally affected. When however the needle is set incorrectly, as for example when in the position indicated in dotted lines in Fig. 11, on account of the plate 17 being placed transversely the field of view must under any circumstances be immediately very noticeably impaired even when the position is only slightly oblique.

In order to damp its oscillations the magnetic needle may be surrounded by a copper case 19. It is also to be recommended to provide the magnetic needle with means for holding it still. In the case of the form shown by way of example this is effected automatically. Namely around the centre of rotation of the needle 12 a ring 20 is arranged, which when raised by the two laterally arranged rods 21 subjected to the action of springs 22 holds the needle firmly until the latter is released by pressure in opposition to the springs which is applied by pressing on the press-button 23.

For the accuracy of the adjustments it is of particular advantage to form the magnetic needle (12) with arms of unequal length, as is shewn in Fig. 8. The shorter arm must then be made correspondingly heavier in order that the needle may be kept in equilibrium. The action of the magnetic needle is then the same as that of a magnetic needle of twice the size of the long arm without it being necessary to provide the room necessary for such a magnetic needle.

Hahn's Improvements in and relating to Telescopes.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is:—

1. Telescope for determining any angles in space adapted for theodolites, levelling-instruments, compasses and also as a telescope for cannon, characterised by the mechanism for adjusting the reflectors and the other parts being so formed and arranged that said parts are either enclosed within the casing proper or virtually form part of the casing by being arranged substantially concentrically outside the casing proper.

2. Telescope as claimed in Claim 1, characterised by a milled screw (*f*) provided with an internal thread being arranged concentrically outside the telescope casing (*s*), on the rotation of which milled screw worm-wheeels (*h*, *i*, *k*, *l*,) engaging with said internal thread move the worms (*m*, *n*) which bring about the motion of the reflectors (*a*, *c*,).

3. Telescope as claimed in Claim 1, characterised by the motion of both reflectors (*a*, *c*,) being effected by only one worm (6) which engages with two worm-wheels each connected with one of the reflectors.

4. Telescope as claimed in Claims 1 to 3 characterised by the device for varying the angle of inclination of the receiving-reflector (*a*) to the horizontal being arranged below the horizontally rotating receiving-reflector (*a*) on the fixed part (*r*) of the telescope and within its casing (*s*).

5. Telescope as claimed in Claims 1 to 4, characterised by the inclination of the reflector (*a*) revoluble about an axle (*t*) being capable of being varied by moving a drum having a helical groove (*w*) said drum being provided with a graduated scale and being displaceable with regard to the fixed part (*r*) of the telescope.

6. Telescope as claimed in Claims 1 to 5, characterised by a ring (2) being inserted between the drum (*w*) and the reflector (*a*) for the purpose of enabling the reflector to rotate horizontally, the reflector (*a*) being held firmly in the necessary manner by spring-action (4) opposing the motion produced by turning the helical drum.

7. Telescope as claimed in Claims 1 to 6, characterised by the reflector-mount being rigidly connected with the ring (2) in this case arranged revolubly.

8. Telescope as claimed in Claims 1 to 7, characterised by an intermediate drum being inserted between the drum (*w*) provided with an internal thread and arranged displaceably on the fixed part of the telescope, and the reflector (*a*), by the opposite movements of which the reflector (*a*) can be moved through very small arcs.

9. Telescope as claimed in Claims 1 to 8, characterised by the telescope being arranged as a binocular in order to permit the observer to observe the objects more conveniently.

10. Telescope as claimed in Claim 1, characterised by a magnetic needle (12) being so arranged that its oscillations can be seen in the field of view of the telescope.

11. Telescope as claimed in Claims 1 and 10, characterised by one pole of the magnetic needle (12) being provided with a setting mark, which swings in a plane parallel with the field of view of the telescope and consequently also parallel with the diaphragm. (hair-cross) 16.

12. Telescope as claimed in Claims 1, and 10, characterised by the magnetic needle (12) being connected in such a way with a perpendicular plate projecting into the field of view, that when the telescope is set in the magnetic meridian free observation is not impaired, whereas when it is incorrectly set the field of view is detrimentally affected.

13. Telescope as claimed in Claims 1, and 10, characterised by the oscillations of the needle (12) being regulated temporarily by a mechanical device, the needle if desired being held still automatically.

14. Telescope as claimed in Claims 1 and 10 characterised by the magnetic needle being formed with unequal arms for the purpose of obtaining larger deflections.

15. Telescope substantially as described with reference to Figs. 1 to 3, or to Figs 4 to 7, or to Figs. 8 to 11 of the accompanying drawings.

Dated this 7th day of January 1907.

CLEMENT LEAN, B.Sc., A.M.I.Mech.E.,
Thanet House,
231, Strand, London, W.C.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1907.